

LIGHTWAVE

FIBER-OPTIC COMMUNICATIONS TECHNOLOGY AND APPLICATIONS WORLDWIDE

JANUARY 1998

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Nortel, Cisco meet across GTE network

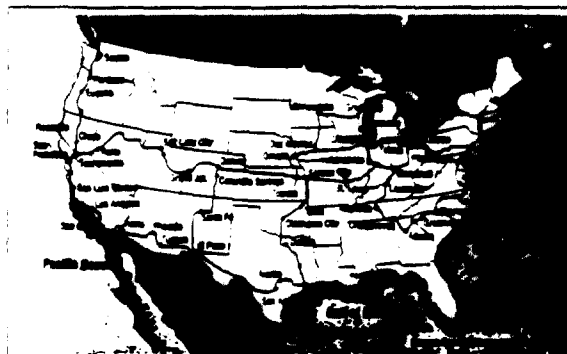
BY STEPHEN HARDY

GTE Corp., Irving, TX, recently rolled out another piece of heavy artillery for its siege of the Internet transport market with the announcement that Nortel, in Brampton, ON, Canada,

will provide GTE Internetworking with 10-Gbit/sec OC-192 and dense wavelength-division multiplexing (DWDM) equipment for a new trans-U.S. fiber-optic net-

work. Nortel joins San Jose, CA-based Cisco Systems Inc. and Qwest Communications Corp., Denver, CO, in the GTE Internetworking camp. GTE has given Nortel and Cisco marching orders to ensure that Nortel's Synchronous Optical Network (SONET) technology meshes smoothly with the Cisco 12000 Series Gigabit Switch Routers that GTE has purchased for the net-

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GTE Internetworking will piggyback the Qwest national network, shown above, to create its own nationwide network. Nortel and Cisco Systems will have the opportunity to hone their interoperability skills as they install their equipment in the network.

Fiber rings service battle waged in New Hampshire

By GRACE F. MURPHY

Across the nation, competitive access providers are rushing through the doors opened by the Telecommunications Act of 1996 and dropping capital into the local telecommunications market.

One company, Brooks Fiber Properties Inc., St. Louis, MO, has gone from 500 to more than 1000 fiber route-mi in the past year, and now has fiber-optic networks in operation or under development in 45 metropolitan areas throughout the nation. Beginning this month, *Lightwave* will begin an occasional series of stories examining Brooks Fiber's efforts to break into New Hampshire's local telecommunications market through the construction of a fiber-optic network.

Construction of a new fiber-optic network in southern New Hampshire between Manchester and Nashua fits Brooks Fiber's strategy of entering second- and third-tier markets with populations between 250,000 and 2 million. According to Keith Markley, general manager at Brooks Fiber Communications in

New Hampshire, Brooks Fiber also prefers to enter markets that don't already have multiple competitive local exchange carriers in place.

According to the New Hampshire Public Utilities Commission, no other competitive local exchange carriers are building networks in the state at the time. However, Vitta Corp., Manchester, NH, and Freedom Ring Communications have interconnection agreements in place with the commission and Bell Atlantic, a regional Bell operating company. The two carriers are buying Bell Atlantic network capacity on a wholesale basis and reselling it and value-added services to customers. Meanwhile, FiveCom Inc., Waltham, MA, runs an arm of its New England Optical Network from Nashua to Manchester as well (see *Lightwave*, June 1997, page 1).

Formed three years ago, Brooks Fiber is working to compete with regional Bells in 5 markets by the end of 1998. The company budgeted \$290 million to fund its national network expansion through 1997 and 1999.

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High speeds, high stakes for gigabit fiber networks 35

Optical transceiver packaging for Gigabit Ethernet and Fibre Channel 42

Serial backplane supports gigabit switch throughput 52

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Telekom Malaysia prepares for a fiber future

By STEPHEN N. BROWN

Despite the recent financial troubles in Southeast Asia, Malaysia continues to upgrade its telecommunications networks. Speaking recently in Singapore, Arshad Bin Ahmad of Telekom Malaysia (TM) emphasized TM's commitment to migrating its high-capacity trunk network from the current mix of Plesiochronous and Synchronous Digital Hierarchies (PDH/SDH) to a fully synchronous one.

Ahmad, TM's manager of PDH/SDH networks, closed his speech with the sugges-

tion that the system migration was a natural consequence of TM's preference for fiber optics. "We at TM believe that optical fiber will continue to be the medium of choice to transport all information," he said. "We will continue to invest in infrastructure based on this medium."

Since 1984, TM has installed 58,500 km of fiber nationwide, with 85% going to the trunk, domestic submarine, and junction networks, and the rest going to the customer-access network. Ahmad gave no indication of TM's future purchase plans or whether TM preferred a certain type of fiber, such as the non-zero dispersion cable now being manufactured by only a few companies.

The migration of the trunks from PDH to SDH will be lengthy and complex. PDH networks allow different high-bit-rate communications streams above 2.048 Mbit/sec (designated as E1 in the Consultative Committee on International Telegraph and Telephone's international digital hierarchy) to

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Lockheed Martin's new site runs ATM over fiber

By GRACE F. MURPHY

Lockheed Martin Corp., based in Bethesda, MD, is known for its cutting-edge spacecraft and military aircraft work, so it is no surprise that it has some of the fastest telecommunications technology on hand for its new Communications and Power Center in Newtown, PA, a suburb of Philadelphia.

The technology includes a \$15 million, 1500-user Ethernet and Asynchronous Transfer Mode (ATM) network with OmniSwitches from Xylan Corp., Calabasas, CA, that are capable of handling multiple fibers transmitting at OC-12 (622-Mbit/sec) rates at each port.

William Dillworth, a communications design analyst for Lockheed Martin, says the company went into the project searching for a system that could handle the new facility's high-traffic needs. Users

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WCMC4022

Nortel and Cisco meet across fiber Internet network

Continued from page 21

work. When this assignment is completed, GTE Internetworking will have a powerful network—and Nortel and Cisco will have valuable experience that could aid them in jointly addressing future large network applications.

GTE formed GTE Internetworking last September. The unit combines GTE Intelligent Network Services, which provided Internet services to residential and small business customers, with the assets that GTE acquired the previous month when it purchased BBN Corp., the ARPANET pioneer and Internet powerhouse. The aim was to provide a broad variety of networking services, such as dial-up and dedicated Internet access, Web hosting, managed security, network management, systems integration, and Web-based application and integration services.

GTE Internetworking hit the ground running thanks to GTE Corp.'s May 1997 purchase of 24 dark fibers on the 13,000-mi national network that Qwest has under construction (see figure; see also *Lightwave* July 1997 page 1). The Qwest network also will use Nortel OC-192 and DWDM equipment to drive traffic over TrueWave non-zero-dispersion-shifted fiber from Lucent Technologies, Holmdel, NJ. However, although GTE Internetworking will share a transport systems vendor with Qwest, it will not share equipment in most cases, according to Steve Blumenthal, vice president and general manager for global network infrastructure at GTE Internetworking.

"We have separate shelters along the right-of-way and separate facilities for terminating, where the optoelectronic equipment will be positioned," he explains. "In a few places, we've made an agreement to share a facility with Qwest. But mostly we have our own separate facilities. So the fiber will come into our facility, and we'll provide the terminating electronics at that point." To equip these facilities, GTE Networking will receive 50 TMS TransportNode OC-192 systems and Multi-wavelength Optical Repeater (WDM) equipment worth more than \$150 million from Nortel.

While GTE Internetworking also purchased additional capacity along the East Coast from sources Blumenthal would not reveal, the company's network construction schedule essentially parallels that of Qwest, he says. Like Qwest, GTE Internetworking's infrastructure will light up from west to east, with a completion date in the later part of this year—although Blumenthal hoped to have some segments carrying traffic last month. The network will initially be linear, with the eventual creation of four SONET rings.

Selling extra capacity

Blumenthal says that the network will serve a variety of customers, including those solicited by other branches of GTE.

"After we've satisfied our internal uses and the needs for GTE customers, we ex-

pect that we will also have additional capacity available for bulk or wholesale sales," he adds. "And we're definitely interested in that business as well."

According to Blumenthal, "We expect that the Internet traffic will be one of the biggest—or other private data network traffic will be the biggest—share of that." Providing high-speed, reliable service will therefore prove of paramount impor-

tance. As a result, Blumenthal has kept a close eye on the current state of the networking art, particularly when it comes to the transmission speeds of data routing equipment. Currently, he is limited to OC-12 (622 Mbits/sec) by the Cisco 12000 Gigabit Switch Router. Asked when he expects to use his fiber network's full OC-192 capabilities, he replies, "That really will depend on the availability of [2.5-

Gbit/sec] cards, and then OC-192 interfaces from router and switch vendors. But the routers that we're deploying in this network will initially be capable of OC-12, and we expect them to be able to move up to OC-48 fairly soon—and then we're hoping to be able to go to OC-192 someday. But that's dependent upon advances in the router and switch technology that we're not controlling directly—but we're providing the requirements to the vendors." Blumenthal left

(Continued on page 21)



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on the four that would lead to a change in router vendors if his requirements warranted.

Thus, the pressure will be on Cisco to catch up the operating speeds of its equipment in the future. Near term, the company will be working closely with Nortel to ensure that its routing equipment interfaces smoothly with Nortel's fiber-optic transport equipment. This shouldn't prove a difficult task, according to Brian McFadden, assistant vice president of high-capacity applications, SONET networks, at Nortel. McFadden says that the two companies will assemble a team of engineers to establish a formal test program using high-fidelity network simulations. The process, the first round of which should be near completion this month, will examine such issues as 1+1 protection switching, the network-wide effects of a ring switch, and what happens when one vendor's equipment or another's loses a node.

Checking fault modes

The engineers should have few, if any, problems that require major changes to the equipment, according to McFadden. "I don't anticipate hardware fixes because, first of all, SONET is a fairly standard interface. At the physical level, it's fairly well-defined down to the optical specs," he explains. "I think the areas where we're probably going to find [inconsistencies]—if we find anything—will be in the fault mode areas: What happens when they initiate a protection switch, what happens when we initiate one, what happens when a node loses power and then powers back up on one side or the other? How does the other system react? So [the interoperability testing will examine] all of the kind of operational modes that can happen in a network and make sure that both systems react the way they're intended to in terms of their design. I don't expect many issues, certainly, if there are issues, it's probably more in the firmware/software domain."

McFadden envisions the two companies working together further to bring additional capabilities to the GTE Internet-working infrastructure. While no formal agreement is in place for such tasks, McFadden says that network management and service development represent potential areas of continued joint endeavors.

Will the experience of working together on this network lead Nortel and Cisco to tackle future business as a team? McFadden says that while it is important that two major equipment vendors in disparate fields can work together in such a fashion, discussion of additional teaming arrangements would only occur "one customer at a time." Still, drawing an analogy to the multivendor work of the SONET Interoperability Forum (see *Lightwave*

November 1997, page 22), McFadden says, "multivendor interoperability, in general, should prove a boon to providers of communications services and bandwidth."

"We're excited about it because I think we're going to ensure that the industry moves forward together on a solid footing when we're talking about Internet protocol networking across SONET," he says.

Meanwhile, Blumenthal looks forward to the capabilities that fiber optics will provide his company and his customers. DWDM, in particular, should prove impor-

tant, he believes. "I think there are some tremendous advantages in DWDM technology in its ability to rapidly provision and reconfigure networks and the fiber, which will help us keep up with the growth that we're expecting in our Internet traffic," he explains. "We're very heavily targeting the Web business, and DWDM will give us the flexibility of really turning up additional bandwidth as the Web hosting business continues to grow. Our traffic on the Internet side is doubling every four to six months." □

REPRINTS

Whatever the purpose, all articles, products announcements and advertisements in *Lightwave* can be reprinted to suit your informational needs.

For information, contact
Kathleen McIntosh at 603/891-3203
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Lightwave is interested in reader feedback. Why not drop us a line at stephenh@pennwell.com?

ATTACHMENT 2

WorldCom Press Release on Local Service Resale, May 15, 1998

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**WORLDCom INTRODUCES NATIONWIDE
LOCAL SERVICE RESALE**

JACKSON, Miss., May 15, 1998 -- WorldCom, Inc., (NASDAQ: WCOM) announced this week it has forged new territory as the first of the major interexchange carriers to offer nationwide local telephone service for resale by carriers and resellers. WorldCom made the announcement at the TRA tradeshow in San Francisco.

The passage of the Telecommunications Act of 1996 accelerated local service competition. WorldCom was the first telecommunications company to effectively enter the retail local market in direct competition with the monopoly Regional Bell Operating Companies (RBOCs) and GTE.

"Entering the wholesale local market underscores WorldCom's end-to-end network advantage," said Bernard J. Ebbers, WorldCom president and chief executive officer. "We're staking our claim as a truly full service provider for our wholesale customers -- offering long distance, Internet, and now, local service from one carrier.

"WorldCom's recognition of the success of resellers in bringing competitive benefits to customers within two years of the signing of the Telecommunications Act is indicative of WorldCom's 15-year history of serving the wholesale market."

Initially, local switched and private line service will be offered in selected U.S. cities where WorldCom has local facilities. Beta testing in these cities has begun. Service will be available in all domestic locations where WorldCom owns local facilities during 1999.

UniDial Communications, a privately-held telecommunications company based in Louisville, Ky., will be WorldCom's first beta customer for local service.

"We're very excited about expanding our relationship with WorldCom," said J. Sherman Henderson III, president and CEO of UniDial. "Innovative and committed partners such as WorldCom have helped UniDial grow. As WorldCom's first local service beta customer, we believe we have enhanced our ability to offer a more complete bundle of

telecommunications services."

Because WorldCom is using its own local facilities, the company will control calls end-to-end, maintaining the highest quality of transmission.

This product is targeted toward wholesale customers. Resellers and other long distance carriers will be able to purchase facility-based local service from WorldCom to sell to end users.

"Our 500-plus carrier and reseller customers have been asking us to provide this service. They recognize WorldCom as the only facilities-based carrier which could provide this service in a cost-effective manner and with the depth of back office support for which WorldCom is known," said John W. Barnett, president of WorldCom Wholesale Services.

WorldCom local services will offer the same simple billing and ordering, rapid provisioning, and dedicated customer support as its long distance service, but more importantly, will offer nationwide local service from one carrier.

Adding local service to its already wide array of products and services allows WorldCom's wholesale customers the ability to provide a single telephone bill, containing both local and long distance charges for customers. This service reflects WorldCom's responsiveness to customer requests for a single bill, allowing its wholesale customers to remain competitive and grow the wholesale market.

WorldCom (NASDAQ: WCOM) is a global telecommunications company with 1997 annual revenues of \$7.35 billion. Operating in more than 50 countries, the company is a premier provider of facilities-based and fully integrated local, long distance, and international voice and data services.

The logo for WorldCom, featuring a stylized 'W' inside a circle, followed by the words 'ORLD' and 'COM' stacked vertically.

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ATTACHMENT 3

Toll-Free Features Competitive Matrix

Attachment 3

Toll-Free Services

These are basic routing features and are used by small and large customers alike.

Toll-Free Features Competitive Matrix*						
Toll-Free Services	WorldCom	AT&T	MCI	Sprint	Frontier	Qwest LCI
Directory Assistance	Yes	Yes	Yes	Yes	Yes	N/A
Message Referral	Yes	Yes	Yes	Yes	N/A	N/A
Call Area Selection	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Routing	Yes	Yes	Yes	Yes	Yes	Yes
Percentage Allocation Routing	Yes	Yes	Yes	Yes	Yes	Yes
Time-of-Day/Day-of- Week Routing	Yes	Yes	Yes	Yes	Yes	Yes
Day-of-Year Routing	Yes	Yes	Yes	Yes	N/A	Yes
Real Time ANI	Yes	Yes	Yes	Yes	N/A	Yes
Dialed Number Identification Service	Yes	Yes	Yes	Yes	Yes	Yes

*Compiled from websites of AT&T, MCI, Sprint, Frontier, LCI and Dr. Bob's Long Distance for Less Updates, 1st quarter 1998.

ATTACHMENT 4

Table of Company & Products

Attachment 4

Company	Product	Description	Market
AT&T	Interactive Advantage	Trouble Reporting, Network monitoring, Call Detail	5K and up
MCI	Traffic View	Network monitoring, Call Detail	5K and up
Sprint	InTouch	Trouble Reporting	5K and up
Ameritech	Netresult Web Interface	Frame Relay, SMDS and ATM performance and trend data	Unknown
Bay Networks	Servicelink	Delivers SNMP data	Unknown
International Network Svc	Enterprise Pro	Polls SNMP data	Unknown
Intermedia Communications	Unknown	Frame Relay and IP monitoring	Unknown
Teleport Communications Group	Unknown	Frame Relay and IP monitoring	Unknown
American Communications Services Inc.	e.espire Managed Services	Frame Relay, IP and ATM monitoring	Small to Mid-sized businesses
Netsolve Inc.	Prowatch Exchange	Trouble Ticket and order status	Unknown
Paradyne Corp.	Framesaver	Integrated network management system that can identify network trends.	RBOCs and other carriers with large frame relay networks
CrossKeys Systems Corp.	Resolve	Frame Relay and ATM monitoring	Unknown
Ellipsys Technologies	Call Problem Analyzer	Packet and circuit-switched traffic	Unknown
Level 3	Un-named	Call detail, invoice, ordering and network monitoring	Unknown
WorldCom	Web NMS	Toll-Free, Frame Relay monitoring, trouble reporting and toll-free routing	5K and up

July 7, 1998

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Attachment 4 (cont.)

Network Control Features

<u>Company</u>	<u>Product</u>	<u>Market</u>
AT&T	Toll-free Routing Control Center	5K+
MCI	Configuration Manager	5K+
Sprint	Command Routing	5K+
US West	BCR (Business Continuation Routing)	Sole Proprietor to Large Business
BellSouth	FlexServ	Multiple location mid-size+ business
Southwestern Bell	NRS (Network Reconfiguration Service)	Not Available
Pacific Bell	FasTrak with CNR	Not Available
WorldCom	Web NMS/CCR	5K+

July 7, 1998

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ATTACHMENT 5

Wholesale Services - Advanced Features

Attachment 5

PRODUCT DESCRIPTIONS

Menu Routing

Menu Routing (MR) allows the caller to select from a list of predefined call paths using the telephone touch-tone keypad. The caller simply dials the 8XX number which connects the caller to a network Audio Response Unit (ARU). The ARU verbally prompts the caller through a series of call completion options. For example, "For Sales press 1", or "For Parts press 2." Once the caller enters a menu selection, the call is routed to the appropriate destination.

MR is often provisioned with pre-Menu call blocking features and post-Menu conditional features. For example, the customer may want calls from California blocked (pre-Menu). For the rest of the country, if the digit "1" was entered for "Sales" after business hours, the customer may want the call to route to a message taking service at another location. This would require the Time-of-Day feature to be invoked after the MR feature, (post-Menu). Retail Marketing has identified post-Menu features as being mandatory before MR is offered.

8XX+PIN

The 8XX+Pin is an enhanced menu routing. Extension routing PIN digits indicate routing selections. A caller enter the PIN digits to route the call to one of several alternate destinations. The Extension Routing PIN digits are cross-referenced in the ESN platform for a valid terminating location and are of a predefined length ranging from 2 to 8 digits (4 being the default). Security Codes are verified PIN codes that allow only authorized callers to connect via an 8XX number provisioned with this feature. The caller dials the 8XX number, waits for the system prompt tone, then enters PIN digits (1 to 12 digits in length).

Call Answering Center

The Call Answering Center allows a domestic call to be routed based on:

- Time-of-Day Routing
- Day-of-Week Routing
- Day-of-Year Routing
- Exchange or NXX Routing (NPA/NXX)
- Area Code Routing (Geographical)
- Percent Allocation

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- **DNIS Delivery**

to a live operator. Prior to answering the call, a 10 digit DNIS are forwarded to the live operator's ACD display where the ACD display identifies the called party (end-user customer) by company name. The operator then answers the domestic call by reading a pre-defined script (customer-provided) and takes a message (up to 80 characters) per callers request. After the caller's message has been written a hard copy can be immediately faxed to the called party (end-user customer) designated fax machine. The operator shall not take orders or perform any kind of customized functions. If a call falls into the ACD queue system, then an appropriate generic or customized message will play telling the caller, "Thank you for calling the 'Company Name.' Please hold. The attendant will be with you shortly.

After Hours/Message Center

Using the end-user pre-defined enhanced 8XX features:

- Time-of-Day Routing
- Day-of-Week Routing
- Day-of-Year Routing
- Exchange or NXX Routing (NPA/NXX)
- Area Code Routing (Geographical)
- Percent Allocation
- DNIS Delivery
-

Calls to the end-user customer's 8XX number are routed to the end-user customer's primary location(s) or calls are routed to the After Hours/Message Center where the calling party will encounter one of the following end-user customer-selected options:

Option A: A simple announcement only, providing the caller with information such as normal business hours, or

Option B: A simple announcement, plus voice mailbox for the caller to leave a message, or

Option C: A simple announcement and voice mailbox with automated outdial or paging notification to alert the end-user customer that a message is waiting.

The Automated Outdial Notification is where the system calls the end-user customer at any pre-defined phone number and plays a pre-recorded announcement upon answering that a message is waiting. The Paging Notification is where the system calls a digital pager or beeper to notify that a message is waiting. As it stands today, page numbers can be changed by the end-user

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customer's by going into their voice-mail menu administrator.

The pre-recorded announcements, as well as messages left by the caller, can be a maximum of 5 minutes in length. The pre-recorded announcements can be generic, customized or professional by direct telephone input to the platform. Calls can be routed to After Hours/Message Center using enhanced 8XX features including:

- Time-of-Day Routing
- Day-of-Week Routing
- Day-of-Year Routing
- Exchange or NXX Routing (NPA/NXX)
- Area Code Routing (Geographical)
- Percent Allocation
- DNIS Delivery

The After Hours/Message Center must have the ability to be used in conjunction with any other basic or future enhanced 8XX feature. Therefore, the After Hours/Message Center must be able to work with the following futuristic features currently being developed:

Menu Routing
8XX+PIN

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WCMC4036

REDACTED

Engineering/IS Direct Development Costs

July 7, 1998

WCMC4037

REDACTED

**Project Timeline - Menu Routing, 8XX+PIN,
Call Answer Center, After Hours/Message Center**

ATTACHMENT 6

Phone+ Magazine article on Resellers' Survey



Wholesale Report Card

Resellers Give Underlying Carriers a C+

By William West and Judy Reed Smith

It's no secret that Wall Street loves network providers. This article was written on the heels of wholesaler Qwest Communications International Inc.'s bid for the much larger retailer LCI International Inc.--a bid that was wholly funded by the smaller company's significantly larger market cap of \$7 billion. At a time when MCI Telecommunications Corp. is being pulled under the WorldCom Inc. umbrella, no one is unconquerable, regardless of size. Wholesale providers of long distance services (both domestic and international) are fighting for more than minutes; they are fighting to remain on top of the acquisition heap.

Most certainly, Wall Street's love affair with network providers gives wholesalers a distinct financial advantage over retail players in the near-term. However, their networks are built for one purpose: to pass telecom traffic. This simple purpose is complex to implement efficiently and reliably, resulting in far-reaching profitability implications for wholesalers and retailers alike. While one would expect to see intensified competition equate to across-the-board improvements in performance among wholesalers, the 1998 edition of ATLANTIC*ACM's Wholesale Long Distance Carrier Report Card, first published in 1996, finds that not to be the case.

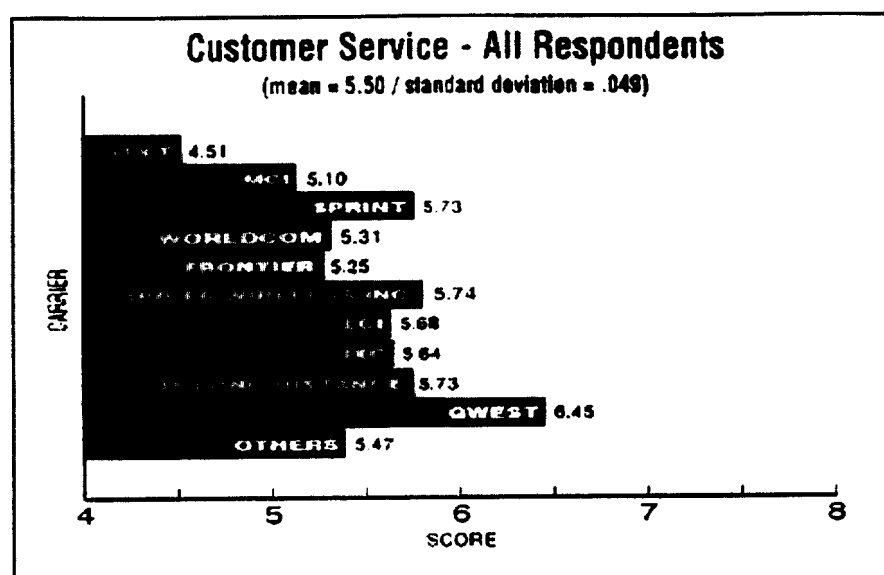
Overall Performance

Based on performance rankings provided by their resale customers, smaller wholesale long distance telecommunications service providers score better overall, particularly among switchless resellers responding to ATLANTIC*ACM's survey. This finding indicates the increasing importance of wholesale services in the overall product mix of these smaller providers which, under the pressure of slimming margins, will allow others to ride their contracts at or near cost to leverage better buying rates from wholesale carriers themselves. This makes the indirect value of the wholesale minute greater than its direct value as it affects the overall profitability of the resellers' retail customers.

Although leading wholesalers have not improved in every category--

provisioning, network, service, products and pricing--ranked in the ATLANTIC*ACM study, they are showing improvements overall. Generally, wholesale customers ranked underlying carriers almost exactly the same as they did in 1996--the equivalent of a C+. As price differences among competitors diminish over time due to falling rates, wholesalers are expected to focus on other categories to find their competitive edge.

Among reseller types--switchless and facilities-based--that responded to the ATLANTIC*ACM survey, individual wholesale carrier scores varied. Sprint Communications Co. and LCI International, along with a group of smaller players classified as "other," received some of the top scores given by switchless resellers. Facilities-based carriers reselling long distance gave their best rankings to Qwest Communications.



Category Rankings

Billing. Generally wholesale carriers performed similarly in 1998 as in 1996, receiving scores slightly above average for both years. As in 1996, larger carriers were ranked below the mean score, earning criticism primarily for their systems' inflexibility.

Provisioning. Wholesale carriers were ranked slightly worse in 1998 than in 1996 for performance in provisioning. Again in 1998, smaller underlying carriers generally outranked the large ones with the exception of Sprint, which scored above the mean--an improvement of nearly a full point (on a scale of one to 10) over their 1996 rankings. Other improvements were noted for LCI International and Qwest, which led the pack in this category.

Network. Overall scores for network quality and reliability were down slightly from the 1996 survey. The Big Four carriers held onto the top spots followed by Qwest, which received an improved ranking from seventh to fourth. Additionally, Frontier Corp. ranked significantly better, up more than a point to capture the fifth spot.

Significantly, MCI nudged out AT&T Corp. for the top ranking among switchless resellers. WorldCom, Frontier and LCI International performed better among facilities-based carriers than among switchless resellers.

Service. As in 1996, service scores, on average, were the lowest among all the categories ranked, suggesting this is still an area where carriers can improve. Qwest scored significantly higher than the other carriers, and improved its score almost two full points over its 1996 score. "Other" providers received the highest scores among switchless resellers, indicating that small wholesalers have found a niche in providing strong service.

Products. Wholesale providers received highest marks in the products category. AT&T earned the highest product scores overall, moving up from eighth in 1996 to first in 1998. The Big Four performed the best among both reseller types that responded to the ATLANTIC*ACM survey. Generally, switchless resellers gave carriers higher scores--7.5 on a 10-point scale--for products than facilities-based carriers, which only allotted 6.8 on the same scale.

Pricing. Rankings for pricing among wholesale providers stayed relatively constant from 1996 to 1998. The Big Four, not surprisingly, scored the worst once again. Bumping Frontier, Qwest became the front-runner in the pricing category for all respondents, up from fifth in 1996. Frontier maintained a high score among switchless resellers, which gave the carrier the No. 2 spot behind the group of various small providers. Scoring by facilities-based carriers followed the trend of high price with large size with the exception of WorldCom, which they ranked third best in price.

Conclusion

ATLANTIC*ACM's survey results reveal that resellers are using more underlying carriers than in 1996, suggesting that opportunities remain for wholesale providers that can supply a competitive product. Declining prices, in particular, are forcing wholesalers to employ new means of differentiation. One response appears to be diversified product offerings, such as wholesalers' advancing international service integration. In addition, low scores in service provision indicate that this area presents an opportunity for a service-oriented wholesaler to gain an edge. In the future, those wholesale providers that demonstrate a service-oriented strategy will be most likely to improve their standing in the industry and improve customer retention.

*William West is principal and Judy Reed Smith is chief executive officer of ATLANTIC*ACM, a Boston-based strategy consulting firm. Information for this article was taken from ATLANTIC*ACM's Wholesale Carrier Report Card published in May 1998. For more information, call (617) 720-3700, fax (617) 720-1077, e-mail atlantic@atlantic-acm.com, or web: www.atlantic-acm.com*

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PLATFORMS '98

QoS Questions

The development race is on to determine how IP traffic will be carried over ATM networks to meet quality of service metrics.

By Carl Weinschenk, Executive Technology Editor, and Peter Lambert, Senior Writer

Internet service providers of all stripes proclaim their networks soon will deliver multiple classes of data service with assured quality for each class. But tough choices about how to get there may have to be made in the coming months. Two main options are available. IP routing is beginning to mature from its best-effort networking roots to being able to deliver different levels of service quality. Then there's asynchronous transfer mode (ATM), an environment created precisely for quality of service (QoS) bandwidth provisioning across the Internet core.

Part of any network design challenge is dealing with legacy infrastructure, and the Internet will have to do so if it hopes to provide the kind of capacity and quality that new applications demand. The bulk of the Internet uses a scheme in which each IP packet travels, router hop by router hop, between two points.

Streamlining this process could boost network throughput significantly. This increasing need for speed is happening at the same time as the development of ATM switching, which eliminates virtually all router hops in the transmission path. The challenge is to put IP packets on ATM networks without the time-consuming step of converting IP packets into ATM cells.

At this point, there are two competing standards for carrying IP over ATM. One is called MPOA (multiprotocol over ATM), and the other is MPLS (multiprotocol label switching). The basic difference between the two is that MPOA uses the concept of a centralized route server, while MPLS uses distributed intelligence. MPLS proponents say this will allow it to scale better.

MPLS is ahead so far in this race partly because it is favored by Cisco Systems Inc. (San Jose, Calif.), which controls about 85 percent of the router market. Cisco and Alcatel N.V. are using what is in essence a prestandard

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version of MPLS in jointly developed products, according to Frank Troccoli, assistant vice president of product line management for Alcatel's enterprise and data networks division.

MPLS is a main element of tag switches (although they're called switches, they really are routers) being developed by Cisco and the 1100 HSS switches by Alcatel, which incorporate the MPLS concept in a feature called IP@ATM. A side benefit of both MPLS and MPOA is that the IP packets traveling on the ATM network will be able to use the QoS capabilities that are inherent in ATM.

Yet members of an emerging carrier camp, including the likes of GTE Corp., Level 3 Communications Inc. (Omaha, Neb.), and Qwest Communications International Inc. (Denver), will end-run the whole QoS debate by overengineering Internet bandwidth, effectively creating so much physical network capacity that congestion virtually never occurs. Under this infinite bandwidth scenario, IP's best-effort delivery always works because packets do not get dropped if congestion doesn't exist.

"The revolutionaries like GTE, Qwest, and Level 3 are building new networks from scratch and really moving toward IP over Sonet," says Chris Brickler, director of enhanced IP service for GTE's business development and integration group. In contrast, ATM-in-the-core advocacy from carriers like the Bell companies is symptomatic of migration from equipment that unnaturally forces packetized content into 64-kbit/s voice circuits, says Fred Ellefson, senior director of marketing and business development for Alcatel's core transport networks.

The lack of legacy gear is a clear advantage to the public network's new breed, agrees Lew Wilks, Qwest's president of business markets. "One of the things that we view as a tremendous advantage is not being burdened by legacy infrastructure," he says. "By building IP on the front edge of the network, we are able to take advantage of new technical initiatives that improve throughput and performance on the physical layer."

Among those physical layer initiatives is dense wavelength-division multiplexing (DWDM), which Qwest will use to multiply the carrying capacity of its fiber. Unlike Williams Communications Group (Tulsa, Okla.), which will rely on both DWDM and ATM in its national fiber network, Qwest will eliminate ATM from its architecture. In the future, Qwest intends even to eliminate Sonet as yet another layer of data forwarding complexity by inserting IP directly into DWDM multiplexers. The result, Wilks says, will be "an insane amount of bandwidth," enabling Qwest and its customers to relax close control over every bit and byte.

GTE intends to migrate away from the regional Bell and interexchange carrier point of view and move all local and long-distance services to a new, state-of-the-art IP network, Brickler says. GTE last year purchased thousands of miles of Qwest fiber strands to reach more than 100 cities with GTE-branded services by mid-1999. The IP backbone of BBN Planet Corp., also acquired by GTE last year and is now part of GTE Internetworking (Irving, Texas), adds another 300 Internet points of presence for GTE. That capacity-rich, IP-centric, circuitless network will deliver QoS for Internet voice, faxing, and messaging and other real-time application classes, Brickler says.

In the meantime, competitive pressures from the IP networking upstarts are being brought to bear on the Bell companies, and that pressure is forcing at least some of the Bells into action. US West Inc. purchased a block of fiber capacity from Qwest earlier this year. Ameritech Corp. plans to follow suit with similar deals, although it hasn't said specifically which backbone provider it might do business with. "We need to follow our customers out of region," says Pat Campbell, executive vice president of strategic and business development at Ameritech.

BellSouth Corp. will decide whether to adopt ATM or advanced routing solutions within the next six months, says Barbara Roden, chief technology officer of Bellsouth.net, BellSouth's Internet services unit. Also on the decision-making track is SBC Communications Inc., which will decide on its backbone future within the next year, according to Marty Loman, director of Internet technologies for SBC Communications Technical Resources Inc.

With the new fiber kings coming to town, can anyone afford to wait?

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